LETTERS TO THE EDITOR.

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Astronomy in the University of London.

IT seems desirable to call special attention to the change which has recently been made in the conditions with regard to astronomy for the B.Sc. Pass and Honours degrees of the University of London. This is the more important as, owing to an unfortunate slip of the much-overworked academic Registrar, the point was omitted from the published examination schedules, and has only been corrected by an attached slip in recent issues.

The point is this, that in future astronomy is to be counted as an independent subject for the B.Sc. degree. It will rank equally with geology, botany or zoology. It is true that the Faculty of Arts has retained a certain amount of astronomy in its mathematical syllabus—in my opinion a very poor syllabus—which represents, not modern astronomy, but the condition of affairs in "three day papers" at Cambridge fifty years ago, when the University of London was founded. Why the Faculty of Arts does not insist also on a little antiquated geology and a little pre-Darwinian biology is cause for wonder. At any rate, the Faculty of Science has recognised that astronomy is a suitable subject for graduation, and we may hope that students of astronomical physics and theoretical and observational astronomy will realise that they can now specialise in London before graduating. A Pass student will be able to graduate by studying mathematics, physics and astronomy, and an Honours student by taking astronomy and *either* mathematics *or* physics. We may hope that a school of astronomy will form itself in London free from the traditions of the Cambridge Mathematical Tripos, and recognising mathematics for the astronomer as ancillary only to observational and physical work. KARL PEARSON.

University College, London, June 15.

De Vriesian Species.

THE recent work of Prof. H. de Vries on the origin of species by mutation has attracted a great deal of attention, although it cannot be said that the facts he presents are of a new kind, or that, taken by themselves, they prove anything about the origin of species. The great merit of the work is to be found in its clear presentation of the subject, with carefully worked out examples, at an opportune time. In former years botanists were not so ready as they are to-day to recognise apparently minor characters as specific, and the great variety of slightly modified plant forms passed almost unnoticed. It was not considered worth while to investigate the polymorphism of the old specific aggregates, and men like Jordan, who did so, were not regarded altogether favourably. The old conception of species seemed to give us a superabundance of plant types, taking the world over; and many botanists thought, as one recently said to me, that it was impossible to catalogue and name the minor forms, *because they were infinitely numerous.* However, there has arisen a new school, especially dominant in America, which recognises the fact that many of the old specific names cover a number of types which are readily distinguishable from one another. These may intergrade, but in many cases they do not seem to do so, and though the distinctions may seem small, they are perfectly constant. The result of the new investigations is in many cases to increase the number of recognised species four-fold, ten-fold, or more. Now when one comes to study these numerous species, it is evident that much of the difference is not absolute, but consists in different combinations of the same or similar characters, like the patterns of a kaleidoscope. With a little ingenuity, one could almost predict the characters of undiscovered forms. Heredity seems every now and then to take a new throw of the dice, with results exactly such as de Vries has described. The successful throws are those which give results adapted to the environment, and these, under the laws governing the survival of the fittest, give us what we proceed to describe as new species.

The proof that species do thus originate is not to be found in garden experiments alone, but must be confirmed by field observations. Unfortunately, the average systematic botanist seems to be much more interested in defending his "new species" than in asking whether they may not be "new" in a more literal sense than he imagines. Nevertheless, search will be made for "de Vriesian species," and thereby the true status of many described plants may be revealed. Two instances of such which have lately come to my notice may be worth recording.

(1) *Helianthus petiolaris phenax* (new variety). Rays 13, mustard yellow, 11 mm. diameter; corollas and stigmas yellow, giving the flower a yellow disc. Found at Boulder, Colorado, August, 1901, growing in a field full of normal *H. petiolaris*, with deep saffron-yellow rays about 8 mm. diameter, and corolla and stigmas a very dark wine red. I took both plants to the meeting of the American Association for the Advancement of Science at Denver, and showed them to an eminent botanist who knows the flora of Colorado well, and is not regarded as a "splitter." I said, "these appear to be forms of one species." "Oh, no," he replied, "one is a Helianthus, the other a Rudbeckia!" However, the flowers were carefully examined in company with Prof. Pammel, and were also shown to Miss Eastwood, and no doubt remained that the new variety was really an offshoot from *H. petiolaris*, which had probably originated where it was found. The variation is the more interesting because in the sunflowers (Helianthus) the colour of the disc is used as a character to separate groups of species.

(2) *Ribes cereum viridior* (new variety). Plant perhaps more resinous; tube of calyx shorter, pale greenish, stigma exserted beyond petals. Fruit deep red, small, perfectly spherical. Found (first by my wife) between San Ignacio and Las Vegas, New Mexico. A clump of bushes presenting these characters (observed in two seasons) grows only a few yards away from plenty of what Mr. Coville considers genuine *R. cereum*, with a longer calyx-tube, streaked with purplish pink, and fruit a little larger and more inclined to be oblong. I was at first quite sure I had a valid species in this *viridior* variety, and Mr. Coville, before we got the fruit, thought the specimens might be his *R. mescalerium*, which has black fruit. Now, however, it appears reasonably certain that the plant represents a de Vriesian "species" or mutation. Miss Eastwood has lately described a somewhat similar mutation of a Californian species, under the name *Ribes sericeum viridescens*. T. D. A. COCKERELL.

East Las Vegas, New Mexico, U.S.A., May 22.

Formula for the Perimeter of an Ellipse.

THE formula given by your Queensland correspondent (NATURE of April 10, p. 536) for the perimeter of an ellipse is not at all objectionable on the score of degree of approximation. It leads, however, to another, which for practical purposes is much preferable. If for shortness' sake λ be written for $\log 2/\log \frac{1}{2}\pi$, he says in effect that the perimeter of an ellipse with semi-axes a and b is approximately equal to the circumference of a circle of radius

$$\left(\frac{a^\lambda+b^\lambda}{2}\right)^{\frac{1}{\lambda}}.$$

Now $\lambda = \cdot 3010300/\cdot 1961199$, two convergents to which are 3/2 and 20/13. Taking the former of these—a course which entails the extraction of no roots other than the square and the cube—we obtain the following result:—The perimeter of an ellipse is approximately equal to the circumference of a circle the radius of which is the semi-cubic mean of the semi-axes of the ellipse (see *Messenger of Math.*, xii. pp. 149–151; *Proc.* Manchester Lit. and Phil. Soc., February 1, 1901).

But by far the best result of this kind known to me may be put in the shape of a rule as follows:—To obtain the radius of a circle the circumference of which will be a close approximation to the perimeter of a given ellipse, diminish twenty-one times the arithmetic mean of the semi-axes of the ellipse by twice the geometric mean and thrice the harmonic mean and divide the remainder by 16. As an illustration of the value of this, we may take the classical example where $a=1$ and $b=\cdot 8$. The three means A, G, H, referred to in the rule are then $\cdot 9$, $\sqrt{\cdot 8}$, 8/9 and

$$\begin{aligned}\frac{21A-2G-3H}{16} &= \frac{18\cdot 9-\frac{4}{5}\sqrt{5}-2\frac{2}{3}}{16},\\ &= \frac{18\cdot 9-(1\cdot 7888544-2\cdot 6666666)}{16},\\ &= \frac{18\cdot 9-4\cdot 4555210}{16},\\ &= \frac{14\cdot 4444790}{16},\\ &= \cdot 90277993\ldots\end{aligned}$$

Now, according to Legendre, the perimeter in this case is $2\pi(\cdot 90277992)$, so that the rule gives the desired result correct to within one hundred-millionth of 2π. THOMAS MUIR.

Cape Town, South Africa, May 19.

The "Armorl" Electro-Capillary Relay.

IN reply to your correspondent "J.-S." (p. 151), I may say that the model which I saw did actually work; it illustrated the flow of mercury from a fine jet when subjected to the influence of a small electromotive force, in the same way as described with reference to Fig. 1 of my article. I think your correspondent slightly misunderstands the principle of the instrument; it is not the small movement of the mercury, such as is used in the ordinary capillary electrometer, which works the relay lever; this movement merely serves to force some of the mercury out of the jet, and the *falling mercury* then moves the lever.

The inventors claimed that they had succeeded in effecting so nice a balance of forces that the mercury flowed from the jet under a very small influence. I join with your correspondent in the desire (which I expressed also in my article) that some trustworthy data concerning the instrument should be published.

June 13. THE WRITER OF THE ARTICLE.

SCIENCE AND MILITARY EDUCATION.

THE report of the Military Education Committee was issued to the public on Saturday, June 7, and has been the subject of much comment in the Press. The conclusions and recommendations of the Committee have been well received on the whole, though there are some exceptions, as in the case of the *Spectator*, which would wish to see Sandhurst done away with, or rather used in an entirely different manner and at a later stage in the officer's career, and in that of the military correspondent of the *Times*, who, in the course of a long article, falls foul of an important passage relating to science, and in effect advises the War Office not to accept or act upon the recommendations of the Committee on this subject. The writer of the article goes so far, indeed, as to suggest that the Committee has not sufficiently considered the evidence, quoting Sir George Clarke in support of the merits of Latin in such a way that we were not a little surprised on turning to Sir George's evidence to find that, when questioned as to the proper preliminary training of cadets (Question 839), he expressed the opinion that they should have a "broad, liberal education," adding that "the broader it is and the wider its scope, and the sounder generally, the better it will fit them for the special training they receive afterwards."

The passage objected to by the *Times* correspondent (20) will be found on p. 5, and, appearing as it does over the signatures of two such eminent representatives of classical training as the head masters of Eton and St. Paul's, is so important that we print it in full. It is as follows:—

"The fifth subject which may be considered as an essential part of a sound general education is experimental science, that is to say, the science of physics and chemistry treated experimentally. As a means of mental training, and also viewed as useful knowledge, this may be considered a necessary part of the intellectual equipment of every educated man, and especially so of the officer, whose profession in all its branches is daily becoming more and more dependent on science."

Considering the uncompromising terms of this statement, it is disappointing to find that a committee holding such clear and strong views should have found itself, in the event, unable to agree upon a scheme which would ensure that this "necessary part of the intellectual equipment of every educated man" should be provided for each and all our future officers. For it cannot be denied that the actual position proposed for science in the scheme recommended, viz. that it should be alternative in Class I. with Latin, will put it in the power of opponents of science to prevent candidates who may come under their influence from having the opportunity of securing this "essential part of a sound general education."

In saying this we do not overlook the fact, as some are disposed to do, that the proposed arrangements will allow those who select Latin as their subject in Class I. to offer science as a Class II. subject, and that, consequently, neither of these two necessary subjects need be neglected. But after making all allowance for the manner in which the scheme as a whole will qualify the effect of the relations of Latin and science in Class I., we think the Committee has not sufficiently regarded the fact that as Latin is begun at a very early age, but chemistry and physics much later, candidates choosing their subjects at about fifteen, as many, and perhaps most, of them must do, will be much more likely to select the former than the latter from Class I. (see Questions 8630, 8631, 8632), leaving science for Group II., where, however, it becomes an alternative with several other subjects, and so is very likely to be squeezed out.

It is a striking illustration of the effects of the neglect of science in our educational system, which even now is being remedied but slowly in some of our schools, that so many soldiers and others still make the mistake of supposing that as regards science the Army only needs "a proportion of scientific experts among military officers for suggesting and following up improvements in *matériel*," and that "the majority of such experts can be better obtained from civilian sources outside the Army than from within its ranks." The last part of this statement is, indeed, in spite of all the fine qualities of our officers, only too sadly true. But it is just because the basis of military education (and indeed of nearly all English education in the case of the abler members of the higher classes) has been too narrow in the past that the Army has failed to throw up a sufficient supply, we will not say of trained scientific specialists, but of officers capable of understanding the specialists, of absorbing their ideas, mastering their methods and applying these in the operations of war. How can we expect average men whose training has been mainly in language and mathematics to be resourceful and confident when brought face to face with the problems created for their profession by the revolutions of the last half century? Every question, said Liebig, one of the creators of much that is strongest in modern Germany, put to science clearly and definitely has been satisfactorily answered before long. Only when the inquirer has no precise idea of the problem to be solved does he remain unsatisfied for long. It is just because the majority of our officers have not had the broadest training possible, that so many are unable to make use of the new powers that science holds out to them, and are still under the mistaken impression that the main use of science in education lies in the facts which it provides.

It is clear that even now many educators and soldiers have not grasped the real elements of this great problem, and that they still fail to see that the object with which science is now taught is, not to convey a few more facts or a few facts of a new kind, but to preserve those habits of mind and that fertility of resource which daily become more important in face of the problems of modern life, and which are not to be gained by a purely literary and mathematical training. All will agree that faculties which must especially be cultivated in our officers "are power of command, habits of leadership, and the ability to act decisively and correctly at the right time and place." But when it is contended, as it often is, that "study in a chemical laboratory does not make for this kind of fitness," it is forgotten that laboratory work properly done will certainly develop these qualities at least as well, and probably better, than any study in